Advanced Distillation Curve Analysis on Ethyl Levulinate as a Diesel Fuel Oxygenate and a Hybrid Biodiesel Fuel

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Diminishing petroleum reserves, the potential of supply disruptions, price volatility, as well as environmental considerations resulting from polluting emissions, have led to development of alternative liquid fuels and fuel additives produced from renewable feedstocks. Recently, a new processing technique has been developed which converts the carbohydrates found in plant biomass into ethyl levulinate, which has properties making it a possible diesel fuel oxygenate additive. Additionally, the new processing technique applied to oil-containing seeds can create a biodiesel fuel at high yields, while enhancing the cold flow properties which commonly plague biodiesel fuels. The first part of this two-part study focused on ethyl levulinate as a possible diesel fuel oxygenate additive, by investigating the volatility of petroleum diesel/ethyl levulinate mixtures. Volatility was measured with the advanced distillation curve (ADC) method for mixtures containing 1, 2.5, 5, 10, and 20 % ethyl levulinate (vol/vol) and compared with unblended petroleum diesel fuel. In addition, the concentration of ethyl levulinate was tracked during the distillation for each mixture by use of the composition explicit data channel. The second part of this study investigated fatty acid-levulinate ester biodiesel blends as viable petroleum diesel fuel extenders/replacements. This was done by measuring their volatilities and comparing them to a commercially available biodiesel fuel, and also to a petroleum diesel fuel. In addition, distillate fractions were withdrawn to measure the changing composition and energy content during the distillation. The composition explicit data channel was used to track the ethyl levulinate concentration as a function of distillate volume fraction, as was done with the mixtures of petroleum diesel fuel described above. This was also used to determine the enthalpy of combustion as a function of distillate volume fraction.